PEER REVIEW HISTORY

ARTICLE DETAILS

TITLE (PROVISIONAL)	Identifying physical and psychological risk factors for musculoskeletal pain in student musicians to tailor the curriculum: a cross-sectional study protocol
AUTHORS	James, Clara E.; Schmid, Audrey; Nguyen-Danse, Dung Anh; Bruyneel, Anne-Violette

VERSION 1 – REVIEW

REVIEWER	Nogueira, Leandro Alberto Calazans Instituto Federal do Rio de Janeiro
REVIEW RETURNED	17-Apr-2023

GENERAL COMMENTS	I read the paper with great interest. This study protocol will examine the risk variables associated with student musicians' practice-related pain. The study protocol describes a broad investigation of potential risk factors. The main outcomes instruments are clearly presented. I suppose that the data collection will be challenging due to the high number of items investigated. Likewise, the authors estimated to recruit 100 participants, which seems to be a low number of participants for the statistical analysis proposed. The study presents promising elements to reveal the physical and psychosocial factors involved with musculoskeletal pain in musicians. There are a few typesetting errors throughout the document. For instance, two bullet points have full stops, and three of them do not have full stop. Please, carefully revise the text. I have pointed out a few minor critiques to assist the authors in improving the quality of the manuscript. Minor Critiques Abstract The authors classified the study design as a prospective cross-sectional study, which seems inappropriate due to the nature of the cross-sectional design. Statistical Analysis The authors proposed an exploratory analysis for cross-sectional studies with repeated measures, but the present protocol will access the participants only once. Could you clarify the use of statistical analysis and the number of time points?

REVIEWER	Guptill, Christine University of Ottawa Faculty of Health Sciences, School of rehabilitation sciences

REVIEW RETURNED	02-May-2023

GENERAL COMMENTS	The concept of this study has merit, and the collaboration between health sciences and music units are to be applauded. At this point, there is a healthy literature on musicians' health, and much of this is not reflected in the introduction. As a result, it is difficult to assess the validity of the protocol, and whether the team has adequate background knowledge to interpret the results. The team might consider consulting with, or adding, an experienced musicians' health researcher to the project, and/or reviewing the detailed comments provided in order to enhance the background information with the extant research, to improve the reader's confidence in the premise and the findings. In addition, a reconsideration of the general health tool, or at least an expanded justification for the use of the tool that was selected, would be appreciated.

VERSION 1 – AUTHOR RESPONSE

Our answers:

Reviewer: 1
Dr. Leandro Alberto Calazans Nogueira, Instituto Federal do Rio de Janeiro

Comments to the Author:
I read the paper with great interest. This study protocol will examine the risk variables associated with student musicians' practice-related pain. The study protocol describes a broad investigation of potential risk factors. The main outcomes instruments are clearly presented.

Our answer: *We thank reviewer #1 for the reading and feedback. We have taken into consideration the requests for revisions.*

I suppose that the data collection will be challenging due to the high number of items investigated. Likewise, the authors estimated to recruit 100 participants, which seems to be a low number of participants for the statistical analysis proposed. The study presents promising elements to reveal the physical and psychosocial factors involved with musculoskeletal pain in musicians.

Our answer: *The total duration of the questionnaires is estimated to be 40 minutes, which may make it difficult for a large number of students to participate. Nonetheless, we have started the study information and are confident of high participation. Therefore, the statistician suggested a sample size of 100, but we are hoping for 200 responses.*

There are a few typesetting errors throughout the document. For instance, two bullet points have full stops, and three of them do not have full stop. Please, carefully revise the text.

Our answer: *Thank you for your comment. We have carefully proofread the text to correct these formal errors.*

I have pointed out a few minor critiques to assist the authors in improving the quality of the manuscript.

Our answer: *We thank reviewer for these comments.*

Minor Critiques
Abstract
The authors classified the study design as a prospective cross-sectional study, which seems inappropriate due to the nature of the cross-sectional design.

Our answer: *We modified this sentence as: "MuSa is a cross-sectional study examining contextual and internal risk variables associated with playing-related musculoskeletal disorders (PRMD) in student musicians."*

Statistical Analysis
The authors proposed an exploratory analysis for cross-sectional studies with repeated measures, but the present protocol will access the participants only once. Could you clarify the use of statistical analysis and the number of time points?

Our answer: *We will use the psychological network methodology (exploratory analysis). There is effectively only one moment of data collection. No repeated measurements are considered for statistical testing. We added more information's in the method part: "There will be only one measurement time for each participant. The time required to complete the questionnaires is estimated at 40 minutes."*

Reviewer: 2
Dr. Christine Guptill, University of Ottawa Faculty of Health Sciences

Comments to the Author:
The concept of this study has merit, and the collaboration between health sciences and music units are to be applauded.

Our answer: *We thank reviewer #2 for the reading and feedback. We have taken into consideration the requests for revisions.*

At this point, there is a healthy literature on musicians' health, and much of this is not reflected in the introduction. As a result, it is difficult to assess the validity of the protocol, and whether the team has adequate background knowledge to interpret the results. The team might consider consulting with, or adding, an experienced musicians' health researcher to the project, and/or reviewing the detailed comments provided in order to enhance the background information with the extant research, to improve the reader's confidence in the premise and the findings.

Our answer: *Studies on the health of musicians are numerous, but on the health of student musicians much rarer. In the introduction, we have focused on the literature on student musicians' health, citing the most recent studies, including the RISMUS study, which is the largest study conducted in Europe in higher music education. We added more references about student musician in the text and more precision about the previous studies.*
The two main applicants of the project have complementary and proven expertise on the health of artists from a physical and mental perspective. Clara James was a professional violinist before becoming an expert researcher in neuroscience and psychology (PhD, Full professor). Anne-Violette Bruyneel (PhD, Professor) has been working for 15 years with professional artists (dancers, musicians and actors), is a physiotherapist and researcher in human movement sciences. We have a proven expertise to lead this project and to interpret the results, this point of complementary expertise

has been raised and has been considered as a strong point by the funders of the project (84'450CHF obtained for the project in a competitive fund). Moreover, Clara James collaborated during 4 years with Prof. Eckart Altenmuller, a neurologist specialized in musician's health, they published 6 papers together. We will be able to consult Prof. Altenmuller at any time. However, his own studies focused primarily on established artists.

In addition, a reconsideration of the general health tool, or at least an expanded justification for the use of the tool that was selected, would be appreciated.

Our answer: *We added in the text justification for the choice of the general health tool: "The self-rated health (SRH) tool allows respondents to self-assess their general health [42]. The SRH outcomes in musicians may have previously been related to the presence of general musculoskeletal pathology and not PRMD [8], while health perception appears to be highly influenced by context [42]. In addition, SRH appears to be a strong predictor of the onset of arm pain [47], supported by the fact that musicians have a predominance of PRMD in the upper extremities [25]. This SRH tool allows an assessment of health in comparison to the past, the same age group, and health conditions' impact on activities. The scale consists of four questions to be scored on a three-point Likert-type scale (Table 2). A high score represents good general health."*

Comments in the .pdf file

Thanks to the proofreader for all these very precise remarks which help us to improve the quality of the text.

CG1: Suggest re-wording this sentence as it is a bit awkward - e.g. Musicians are at higher risk of….
Our answer: *We modified as: "Insufficient identification and understanding of risk factors make musicians engaging in professional practice particularly vulnerable to musculoskeletal pain."*

CG2: Is it related to practice only? Or both practice and performance?
Our answer: *We modified the sentence as: "MuSa is a cross-sectional study examining contextual and internal risk variables associated with playing-related musculoskeletal disorders (PRMD) in student musicians."*

CG3: Unfortunately, since the reference provided cannot be accessed, I am unable to determine whether it is an appropriate reference for these two statements. I have not seen any other publications that would support a determination that MSDs are always (or most often) first physical, and couldn't - for e.g. - have simultaneous mental and/or social impact; nor one that supports a constant increase in reported MSDs (Is it constant, or is it exponential? Is this only in Europe, or worldwide?).
Our answer: *The reference is effectively no longer available. We modified the text with new references. However, your remark is highly pertinent. We now provide a more comprehensive discourse on the dynamics of physical pain and mental problems in the revised manuscript, with supplementary references.*
We modified the text as: "Musculoskeletal health plays a central role in people's daily lives, as it guarantees autonomy and unrestricted participation in socio-professional and leisure activities [1]. Musculoskeletal disorders (MSD) induce pain, reduce motor function, and impair mental and social well-being [2]. In 2019, three out of five people reported work-related MSD in Europe [3]. Although physical problems generally first set in [3], musculoskeletal disorders (MSD) can involve physical and mental factors, with each influencing and exacerbating the other [4] and mediated by neurochemistry [5]. This situation highlights the importance of redirecting care toward primary prevention rather than biomedical treatments, as these are often ineffective once the injury has occurred [2]."

CG4: Is the only way to develop preventive approaches by promoting individuals' active participation? Seems to me that employers, educators, and policy-makers have an important role to play. Might consider changing this latter portion of this sentence.
Our answer: *Indeed, this aspect should be nuanced. We have deleted the end of the sentence.*

GC5: Not totally sure what is meant here - do you mean psychologically stressful? And what are repeated stressful situations?
Our answer: *We modified the text as: "Occupational activities involving high physical strain combined with psychologically stressful situations are associated with a significant increase in MSDs [7]."*

GC6: Possible re-wording - I'm not sure musical practice 'induces' repetitive movements, but it certainly involves and requires them.
Our answer: *We modified the text as: "Musical practice involves intense, often complex, rapid movements accompanied by high psychosocial demands [8,9]."*

GC7: Of course the movements aren't always complex nor at high speed.
Our answer: *We modified the text as: "Musical practice involves intense, often complex, rapid movements accompanied by high psychosocial demands [8,9]."*

GC8: This reference does not seem appropriate to support the statement.
Our answer: *We modified the reference.*

GC9: Is reference 9 supporting this sentence? If so, it should appear at the end of this sentence; and it needs to be clear that it is not specific to musicians. If not, a reference is needed for this statement.
Our answer: *We added a reference and we modified the sentence as: "In fact, in sports, the leading risk factor for health problems in children and adolescents is the increasingly progressive specialization of practice at higher levels of performance [12]."*

GC10: References should be used for this statement; and if sport, then please apply caution or specify that not all of the supporting references are specific to musicians.
Our answer: *we modified the text and added reference: "Children and teenage musicians who aim to become professional musicians begin their training at an early age and are quasi-systematically involved in specialized instrumental practice, elevating the risk of MSDs. While studies of children with specialization practice are limited, Aparicio et al. (2016) found a higher prevalence of pain in musician children compared to non-musicians [14], and 14% of adolescent music students report playing-related musculoskeletal disorders (PRMD) [15]."*

GC11: There are relevant studies in musicians' health that could be referenced here.
Our answer: *We completed references about the children and student musicians. "For other artistic practices (e.g., dance), previous studies have shown that transitioning from leisure to professional practice is a particularly critical time for health problems to arise [16]. When students enter higher education, the volume and intensity of practice increase sharply, and the competition is intense. The difference between success and failure is played out on stage in front of an informed public, creating tension [17]. Studies have shown a higher prevalence of pain, stress, psychological issues, and the use of medical treatment among student musicians compared to non-musicians [18–21]. Nevertheless, musicians often rate their health status more positively, which could be directly linked to the "no pain, no gain" mentality [18]. The prevalence of observed disorders appears to be higher among first-year students and in master's degree programs, highlighting the need for implementing enhanced prevention programs specifically tailored for new students [19,22]. While studying at a conservatory for professional musicians, approximately 10% of student musicians experience critical health problems that can significantly impair their learning or require them to stop their curriculum [22]."*

GC12: It is true that it has not be ‘thoroughly’ studied, but it has been studied.
Our answer: *We modified the sentence: “This transitional period at the start of professional training, which poses increased risks of musculoskeletal disorders (MSD), has not been thoroughly studied among student musicians. However, professors at the Geneva University of Music (Haute école de musique de Genève - HEM) observed fragility and encountered difficulties in managing health issues among their undergraduate students.”*

GC13: Indeed - many have noted the need for specialized health support. Referencing some of this work would be helpful.
Our answer: *We added references about prevention support. “Moreover, student musicians need health support tailored to their needs and their instrumental practice. Some studies showed a beneficial effect of preventive actions when support was adapted to the specific context [19,23].”*

GC14: Compared to?
Our answer: *We modified the text as: “Despite the known risks and the fact that musical practice can be compared with physical activity because of the repetition and intensity of complex movements [24], musicians rarely benefit from the health support found in sports disciplines during their learning process and professionalization.”*

GC15: Some of these articles are not students. Please be cautious about which references are used to support statements.
Our answer: *We added precisions in the text: “In a 2018 European study involving 560 student musicians, 65% of participants reported PRMD over the past 12 months [8]. A systematic review of 21 articles (involving 5,424 professional musicians) dealing with MSDs in musicians showed that prevalence varied from 41% to 93% [25]. The pain, even if it does not have a clearly identified cause, generates significant mental and physical fatigue that affects the quality of learning for student musicians or may even necessitate a career break [8]. In professional musicians, the upper limbs and neck seem to be the most affected areas [25–27], but the specific locations of disorders vary depending on the positioning of the upper limbs in relation to the instrument [8], as well as the overall posture [28].”*

GC16: There are certainly more studies on risk factors than have been listed here.
Our answer: *absolutely, we now added several more references in this list. We added the recent study of Bellanberger et al. 2023 for the risk factors specifically identified in music students.*

GC17: Foxman et al. were not the first or only to propose such a classification. I believe the first application of such language was Zaza in 1993: https://www.jstor.org/stable/45440732
Our answer: *Thank you for the link of this original paper. We modified the sentence as: “Zaza et al. (1993) propose the same classification for musicians [32].”*

GC18: Be cautious about using terms like imprinting, which is a specific process.
Our answer: *We modified the text as: “Repeated improper movement patterns, influenced by the aforementioned factors, can lead to brain plasticity cases similar to those observed with optimized movement patterns [17].”*

GC19: Performance anxiety
Our answer: *We modified the text as: “Some authors have developed validated questionnaires to assess musculoskeletal pain [26,37] and performance anxiety [38] in musicians that should be more widely used.”*

GC20: Could you please explain a bit more about this approach, and why it would be relevant?

Our answer: *We added explanation about this method: "Moreover, the statistical approach of psychological network analysis has not been used previously, although it is relevant for identifying the strength of the relationships between risk factors and PRMDs [39]. Network analysis refers to a statistical approach used in psychological science to examine and understand complex relationships among multiple variables. It involves analyzing the interconnections and dependencies between variables to uncover hidden patterns and dynamics within a system [39]. Network analysis involves visualizing complex relationships among variables using nodes (representing variables) connected by edges of varying thickness to indicate the strength of connections. It is a valuable tool for exploring and interpreting relational data, particularly when dealing with many variables [39,40]."*

GC21: Please spell out the acronym the first time it is used.
Our answer: *The acronym is explained above, but we have improved clarity by adding the French name. "However, professors at the Geneva University of Music (Haute école de musique de Genève - HEM) observed fragility and encountered difficulties in managing health issues among their undergraduate students."*

GC22: Please define 'practice'.
Our answer: *We added the description: "Physical risk factors influencing the development of pain and musculoskeletal disorders (MSDs) in instrumental playing include age, gender, duration of daily instrumental practice (including individual training and HEM courses), lack of warm-up exercises and breaks, sedentary lifestyle, and sleep duration."*

GC23: Which personality traits? You have not mentioned this before, so I am unable to tell whether this is warranted and related to the literature.
Our answer: *In the introduction part: "In the psychological domain, factors such as self-perceived health, stress, and perfectionism play a role [9,33,34]. These psychological factors align with personality traits based on the Big Five model: openness, conscientiousness, extraversion, agreeableness, and neuroticism [41]."*

GC24: This seems to only account for 550 students…
Our answer: *It is a mistake linked to the fact that at the beginning, we considered only the site of Geneva, but to obtain more participants, we opened the questionnaire to the site of Neuchâtel. We can affirm today that this opening will allow us to obtain a higher number of participants than the minimum of 100 targeted. We modified the text as: "The HEM has more than 550 students from the five continents, nearly 90% of whom are performers. About 250 of them are enrolled in the Bachelor's program and more than 300 in the various Master's programs"*

GC25: If you are including singers, there should be a portion of the introduction devoted to MSK disorders of the voice - or at least, more literature on the voice in the introduction.
Our answer: *We added these MSD in the introduction part: "Some specific risk factors have also been identified according to practice, for example, singers with 46% of dysphonia over their careers [35] and 13% to 20% of flutists presenting jaw disorders [36]." And in the abstract: "A subgroup comparative analysis will be will be then applied according to the instrumental subcategories and work postures, including singers."*

GC26: Why? For e.g., if a student had an appendectomy in the last 12 months, is that relevant?
Our answer: *Th exact criteria is the surgery in the last 12 months that affect music practice.*
We modified the text as: "Students who have undergone surgical interventions in the previous 12 months that affect music practice.

GC27: Could you provide more information here? How many of the students would have English or French as a first language? What is the language of instruction in the program?

Our answer: *The teaching is given mainly in French (B2 level required for inscription), but some students have a higher level of understanding in English. We have therefore left the choice of the language used to the students. This point was requested by the fund supporting the project.*
We modified the text as: "Given the high number of international students, the questionnaire is offered in French and English."

GC28: I'm not sure what 'free questions' means? The reference says it was 'inspired' by an HEM music professor: Just one? More detail about this would be helpful.
Our answer: *We added more details: "The free-form questions were based on Cruder et al.'s (2020) approach [8] and arose from discussions with two music teachers, the head of research, and the pedagogical coordinator of the HEM, as well as on pre-tests with music assistants."*

GC29: The self-rated health item was developed and validated in older adults who are not musicians. The cited source (25) is not the original development of the questionnaire. Not sure why this item would be chosen over other short, self-reported items such as the SF-6 or the EQ-5D, which might even have norms for an appropriate age group?
Our answer: *We added more details in the text: "The self-rated health (SRH) tool allows respondents to self-assess their general health [42]. The SRH outcomes in musicians may have previously been related to the presence of general musculoskeletal pathology and not PRMD [8], while health perception appears to be highly influenced by context [42]. In addition, SRH appears to be a strong predictor of the onset of arm pain [47], supported by the fact that musicians have a predominance of PRMD in the upper extremities [25]. This SRH tool allows an assessment of health in comparison to the past, the same age group, and health conditions' impact on activities. The scale consists of four questions to be scored on a three-point Likert-type scale (Table 2). A high score represents good general health."*

GC30: Please reference the primary source for the Kessler scale.
Our answer: *We added the Kessler source.*

GC31: Since you included singers, you would have to adapt it for that group as well, since it was developed for instrumentalists.
Our answer: *We modified the text as: "A minor set of specific questions on orchestra playing were adapted to student musician settings (instrumentalists and singers), staying as close as possible to the original text."*

GC32: This is not a term used in North America; not sure if another phrase might be more universally understood? Educational history perhaps?
Our answer: *We modified by "educational history"*

GC33: More information about which instrument subcategories you plan to use and what you mean by work postures (standing vs sitting? Upper strings vs lower strings?) would be helpful.
Our answer: *We added more details in this part: "Participants will then be categorized according to instrumental subcategories (instrumentalists according to arm position and singers) and work postures (standing, sitting, or both), and results will be compared between groups if the number of students per group is sufficient."*
GC34: This information should be in the methods section, and would add face validity for your new questions.
Our answer: *We have moved this part to the method.*

VERSION 2 – REVIEW

REVIEWER	Nogueira, Leandro Alberto Calazans Instituto Federal do Rio de Janeiro
REVIEW RETURNED	15-Jun-2023

GENERAL COMMENTS	The authors have carefully revised the protocol. I have no further issues.